



EPRI Power Plant Cooling Technology Innovation Research and Water Resource Center Overview



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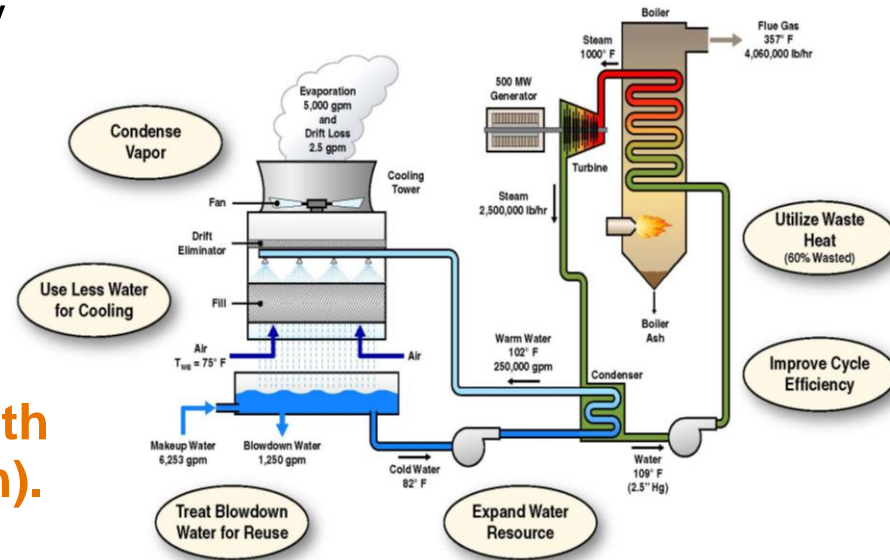
DOE ARPA-E Alternative Power Plant Cooling Workshop

May 12-13, 2014

Hotel Chicago, Chicago, IL

EPRI's Approach

- Initiated water conservation technology innovation research in early 2011
- Collected 168 proposals/white papers from 3 solicitations
 - [Feb., 2011](#)
 - [June, 2012](#)
 - [May, 2013](#) (\$6 M Collaboration with The National Science Foundation).
- Funded 14 projects including 4 water treatment projects
- Funding 6 more projects in 2014



Objective

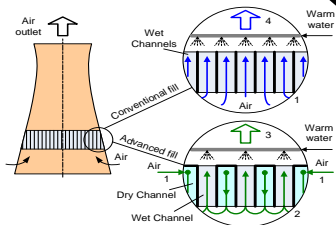
Seek and develop “out of the box”, game changing, early stage, and high risk cooling and water treatment ideas and technologies with high potential for significant water consumption reduction.

Current Cooling Projects excluding projects funded through NSF-EPRI Collaboration Program

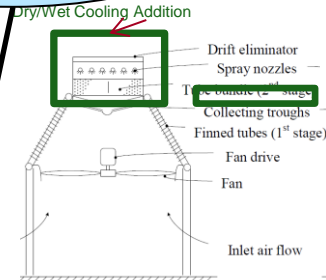
1. Water Spray to Enhance Air Cooled Condensers (Collaboration with University of Stellenbosch in S. Africa)
2. **Nearly 100% Vapor Capturing Technology** (Collaboration with UMD)
3. **Waste Heat/Solar Driven Green Adsorption Chillers for Steam Condensation** (Collaboration with Allcomp)
4. Thermoelectric Cooling and Waste Heat Recovery Technology (Collaboration with Purdue)
5. **Thermosyphon Cooler Technology** (Collaboration with Johnson Controls)
6. Advanced M-Cycle Dew Point Cooling Tower Fill (Collaboration with Gas Technology Institute)
7. Heat Absorption Nanoparticles in Coolant (Collaboration with Argonne National Lab)
8. Parametric Evaluation of Effects of Nanofluid on Cooling Tower Evaporation Loss Reduction (Collaboration with GTI)
9. Emerging Heat Transfer Enhancement Technology Evaluation (Collaboration with UIUC)

EPRI's Advanced Cooling Technology Pipeline

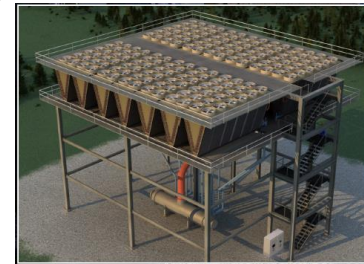
Dew Point Cooling



Hybrid Dephlegmator



Thermosyphon Cooler



| TRL 1 | TRL 2 | TRL 3 | TRL 4 | TRL 5 | TRL 6 | TRL 7 | TRL 8 | TRL 9 |
|----------------------|---------------------|----------------------------|----------------------|------------------|---------------------|---------------|-----------------------------|-------------------|
| Exploratory Research | Concepts Formulated | Proof of Concept Validated | Subsystem Validation | System Validated | Early Demonstration | Demonstration | Early Commercial Deployment | Commercialization |

**EPRI Water
TI Program**

**EPRI Water
Management
Technology
Program**



Status/Update: Water Research Center (WRC) at Georgia Power's Plant Bowen

Russell Noble

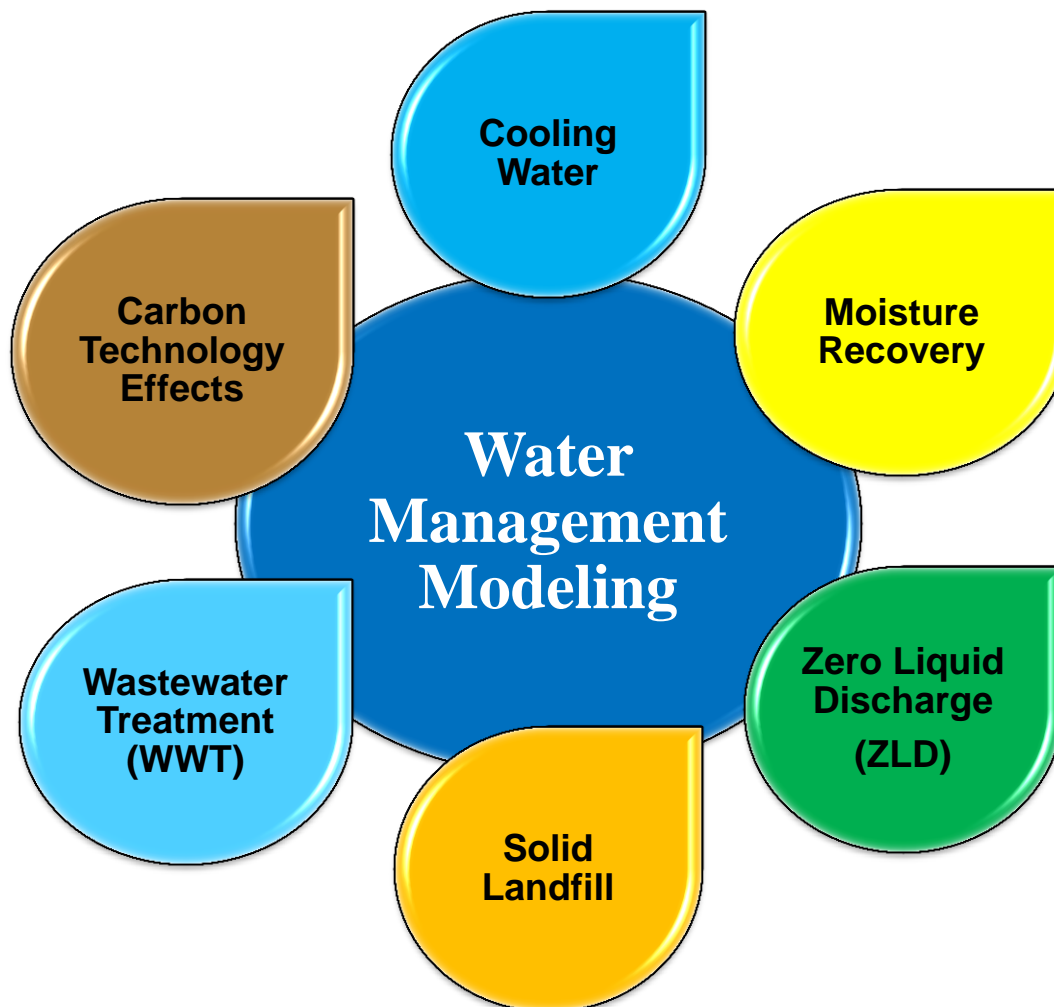
Power Generation R&D Manager
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Presented by **Jessica Shi**, EPRI Sr. Technical Leader/Manager

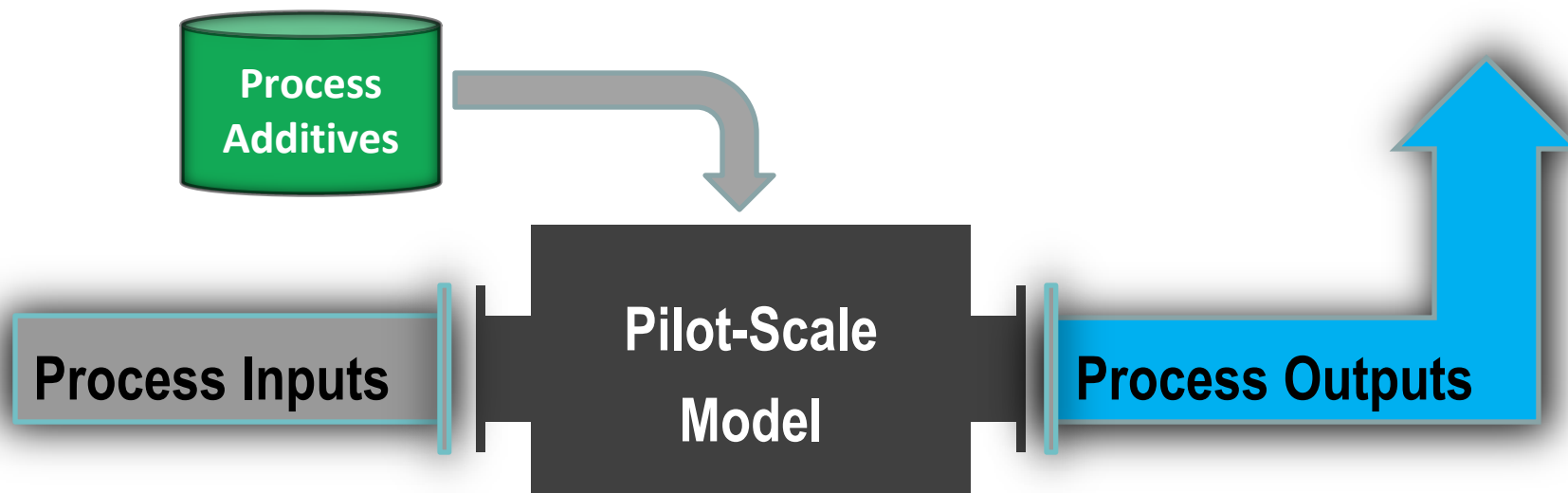




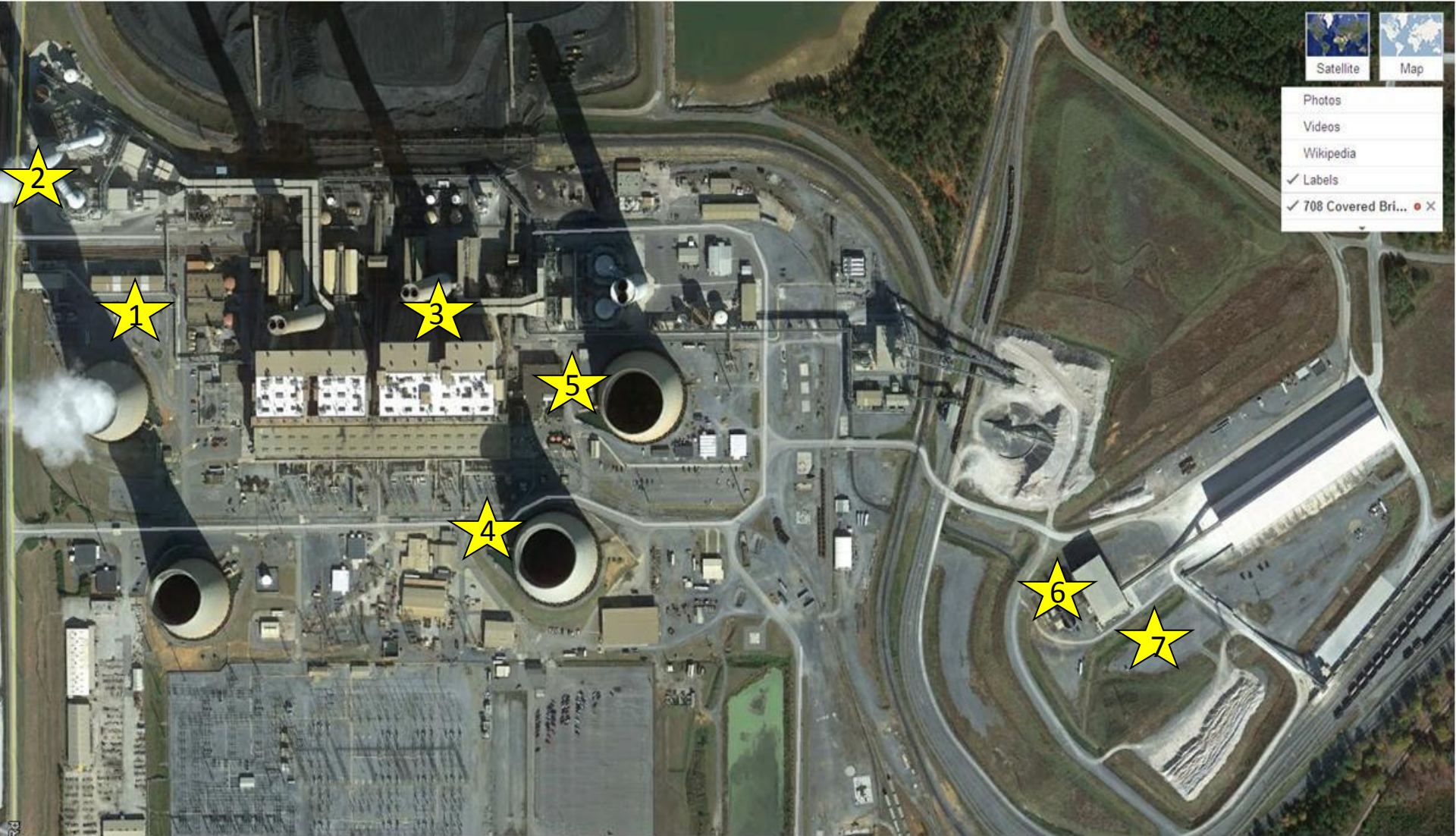
Focus Areas



Pilot-Scale Model



Generic Infrastructure for Testing



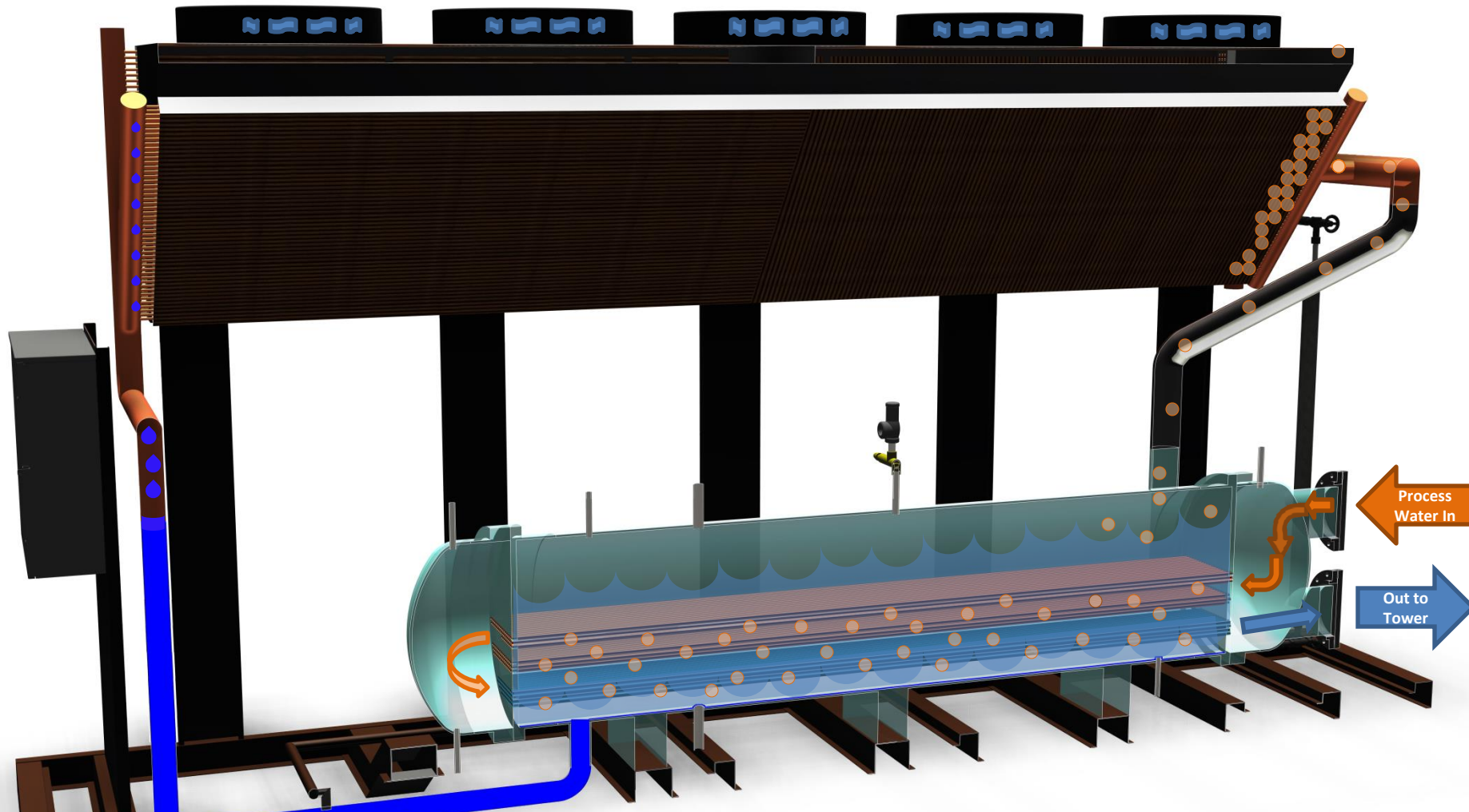
1. WRC Lab (evaporator, crystallizer, lysimeters, etc.)
2. Wet ESP / Moisture Recovery
3. Heartland Evaporator/Concentrator
4. EVAPCO Eco Wet-Dry Cooler

5. JCI Thermosyphon Cooler
6. Atlantis RDI – VSEP Memb.
7. Wastewater Treatment Bldg

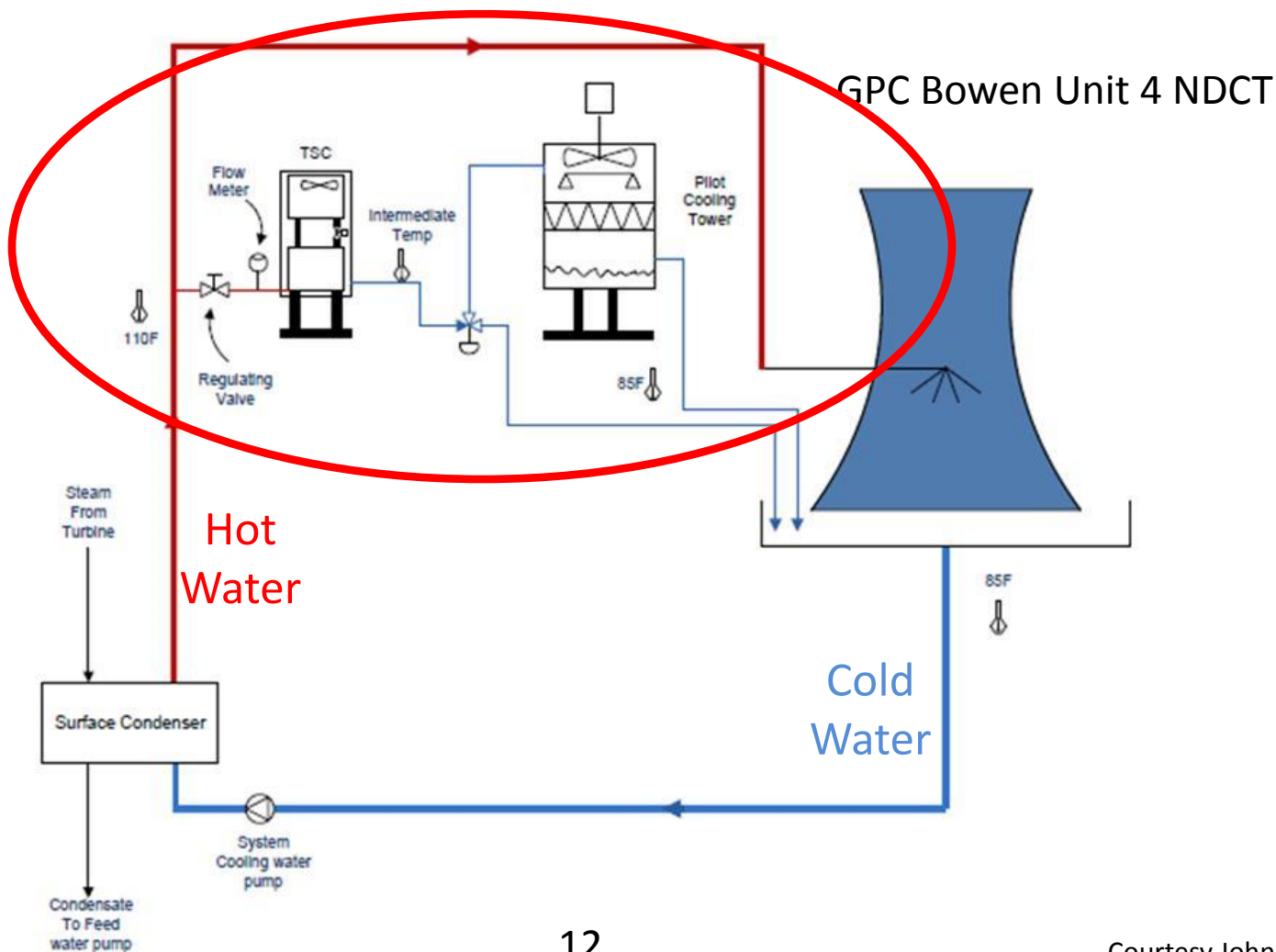
Example Projects

- Johnson Controls' Thermosyphon Cooler (TSC)
- EVAPCO Eco Wet-Dry Cooler (Eco-WD)
- Atlantis Technologies' Radial Deionization (RDI)
- Wet Electrostatic Precipitator (Wet ESP)
- Heartland Evaporator/Concentrator
- Wastewater Treatment Research (WWT Building)
- Solids Management Research

Thermosyphon Cooler (TSC) – Advanced Cooling



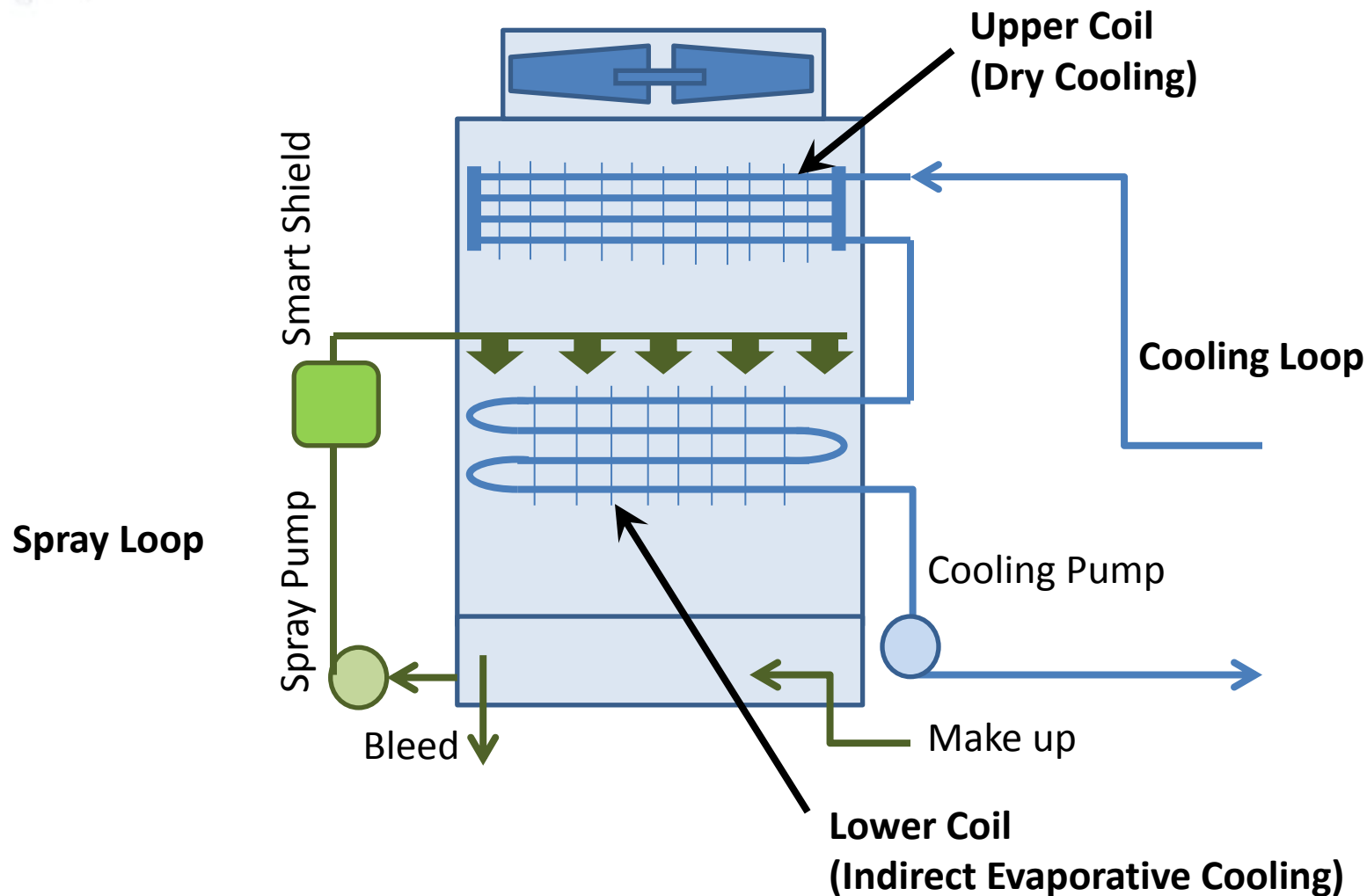
TSC – Hybrid System Configuration



TSC Hybrid System



Evapco: Eco-WD Cooler



Evapco Eco-WD Cooler



Wet ESP and Water Reuse

Evaluate New Design

- Performance & Durability
 - SO_3 and fine filterable particulate matter
 - Trace metals (Hg, Se, etc..)
 - Fabric membranes and coated carbon steel

Explore Water Recovery

- Characterize condensate
- Treatment strategies
- Water reuse potential



Tech Transfer from Oil & Gas (ZLD)



HEARTLAND
TECHNOLOGY PARTNERS, LLC

- Portable brine concentrator
- Proven on 250,000+ ppm brines
 - “Frac” waters
 - Landfill leachate
- Alternative ZLD for FGD wastewater
- Project commence 2nd quarter 2014



WWT Research Area



Completed and Ongoing Projects

- Atlantis Radial Deionization
- VSEP Vibrating Membrane
- Evoqua Pironox Zero-Valent Iron Process Demo



Solids Management Research

- Characterization of new WWT and ZLD solids/residuals
 - Baghouse, spray-dryer, thermal ZLD, etc
 - Significant fractions of RCRA metals
- Solidification/Stabilization and long term leachate characterization
- Lysimeter on-site and being installed
- Evaporator/Crystallizer being installed



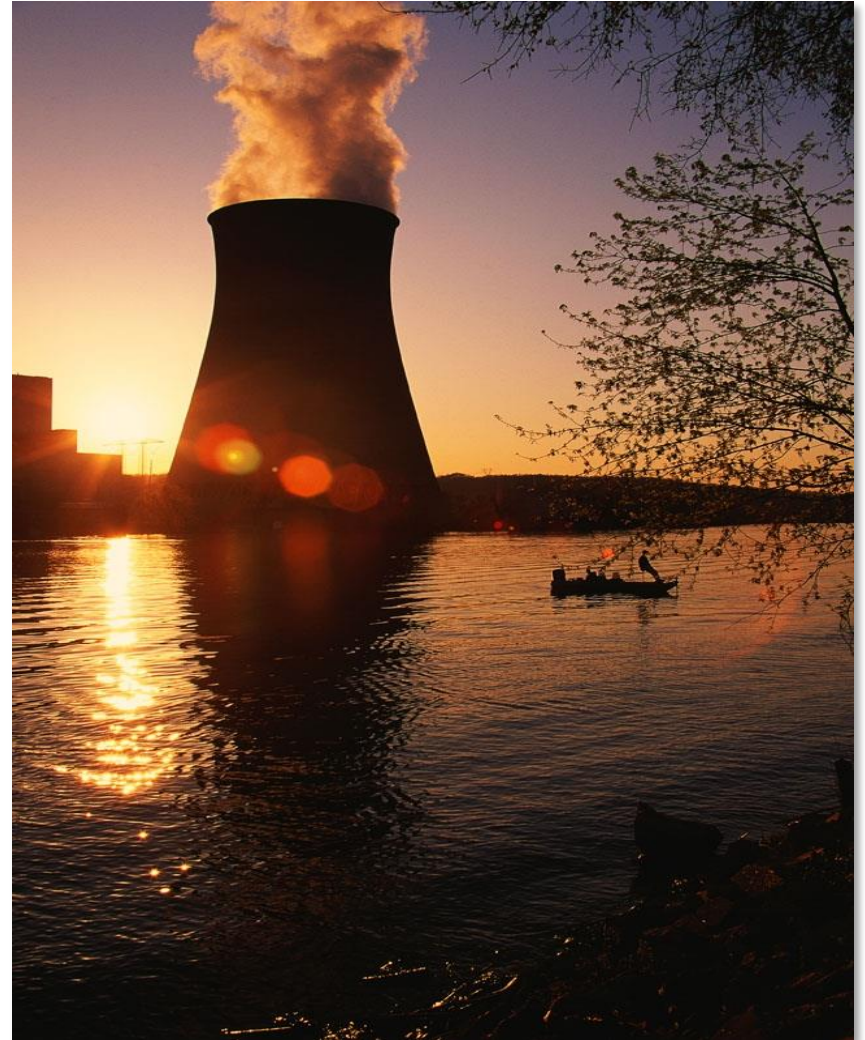
End Results...

- Establishment of a world-class R&D center
 - Industry resource for R&D
 - Generic infrastructure for testing
 - Accelerate water technology R&D
- Prove, disprove, and improve



Concluding Thoughts

- EPRI's research indicates that with more engagement of the research community and more funding, there is a high potential to dramatically reduce water use in power plant cooling.
- Water Research Center is poised to host more field demonstration projects.





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